



US009646574B2

(12) **United States Patent**
Hoellwarth

(10) **Patent No.:** **US 9,646,574 B2**
(45) **Date of Patent:** **May 9, 2017**

(54) **HEAD-MOUNTED DISPLAY APPARATUS
FOR RETAINING A PORTABLE
ELECTRONIC DEVICE WITH DISPLAY**

G02B 27/0172; G06F 1/163; G06F
1/1637; G06F 3/011; G06F 3/012; G06F
3/013; H04M 1/05; H04M 1/6041; H04M
1/6058; A42B 1/245

(71) Applicant: **Apple Inc.**, Cupertino, CA (US)

(Continued)

(72) Inventor: **Quin C. Hoellwarth**, Kuna, ID (US)

(56)

References Cited

(73) Assignee: **Apple Inc.**, Cupertino, CA (US)

U.S. PATENT DOCUMENTS

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

4,575,722 A 3/1986 Anderson
5,003,300 A 3/1991 Wells

(Continued)

(21) Appl. No.: **15/274,901**

FOREIGN PATENT DOCUMENTS

(22) Filed: **Sep. 23, 2016**

DE 10047237 7/2002
DE 10103922 7/2002

(Continued)

(65) **Prior Publication Data**

US 2017/0011716 A1 Jan. 12, 2017

Primary Examiner — Stephen Sherman

(74) *Attorney, Agent, or Firm* — Joseph F. Guihan

(57)

ABSTRACT

Head-mounted display systems and methods of operation that allow users to couple and decouple a portable electronic device such as a handheld portable electronic device with a separate head-mounted device (e.g., temporarily integrates the separate devices into a single unit) are disclosed. The portable electronic may be physically coupled to the head-mounted device such that the portable electronic device can be worn on the user's head. The portable electronic device may be operatively coupled to the head-mounted device such that the portable electronic device and head mounted device can communicate and operate with one another. Each device may be allowed to extend its features and/or services to the other device for the purpose of enhancing, increasing and/or eliminating redundant functions between the head-mounted device and the portable electronic device.

26 Claims, 25 Drawing Sheets

Related U.S. Application Data

(60) Continuation of application No. 15/246,340, filed on
Aug. 24, 2016, which is a continuation of application
(Continued)

(51) **Int. Cl.**
G09G 5/377 (2006.01)
G02B 27/01 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC **G09G 5/377** (2013.01); **G02B 27/0093**
(2013.01); **G02B 27/017** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC G02B 27/017; G02B 27/0156;

